

IN THE CLAIMS:

No claims are amended herein. Please note that all claims currently pending and under consideration in the referenced application are shown below, in clean form, for clarity.

1. (Previously Twice Amended) A residue-free contact opening in a dielectric layer for a semiconductor device extending from an upper surface of said dielectric layer to a metal-containing conductive pad, having substantially parallel sidewalls and formed by a method comprising:

providing a semiconductor substrate having a metal-containing conductive pad;
forming said dielectric layer over said semiconductor substrate and said metal-containing conductive pad with at least one opening extending from an upper surface of said dielectric layer to said metal-containing conductive pad and including a residue residing within said at least one opening;

applying nitric acid within said at least one opening; and
subsequently applying a phosphoric acid-containing solution within said at least one opening.

2. (Previously Twice Amended) A contact within a residue-free opening in a dielectric layer for a semiconductor device extending from an upper surface of said dielectric layer to a metal-containing conductive pad, having substantially parallel sidewalls and formed by a method comprising:

providing a semiconductor substrate having a metal-containing conductive pad;
forming said dielectric layer over said semiconductor substrate and said metal-containing conductive pad with at least one opening extending from an upper surface of said dielectric layer to said metal-containing conductive pad, and wherein a residue resides within said at least one opening;

applying a nitric acid within said at least one opening;
subsequently applying a phosphoric acid-containing solution within said at least one opening;
and

disposing conductive material within said at least one opening.

3. (Previously Twice Amended) A residue-free contact opening in a dielectric layer and a barrier layer for a semiconductor device comprising a semiconductor substrate having a metal-containing conductive pad under said dielectric layer and said barrier layer, said residue-free contact formed by a method comprising:

- providing a semiconductor substrate having a metal-containing conductive pad;
- forming said barrier layer over said semiconductor substrate and said metal-containing conductive pad;
- forming said dielectric layer over said barrier layer;
- forming a first via portion through said dielectric layer to expose a portion of said barrier layer, said formation of said first via portion forming an oxide polymer residue within said first via portion;
- forming a second via portion through said exposed portion of said barrier layer, said formation of said second via portion forming a metal polymer residue within said first and second via portions;
- applying nitric acid within said first and second via portions to remove said metal polymer residue; and
- subsequently applying a phosphoric acid-containing solution within said first via portion to remove said oxide polymer residue.

4. (Previously Twice Amended) A residue-free contact opening in a dielectric layer and a barrier layer above a metal-containing conductive pad for a semiconductor device, said residue-free contact formed by a method comprising:

- providing a semiconductor substrate having a metal-containing conductive pad;
- forming said barrier layer over said semiconductor substrate and said metal-containing conductive pad;
- forming said dielectric layer over said barrier layer;

forming a first via portion through said dielectric layer to expose a portion of said barrier layer, said formation of said first via portion forming an oxide polymer residue within said first via portion;

applying a phosphoric acid-containing solution within said first via portion to remove said oxide polymer residue;

forming a second via portion through said exposed portion of said barrier layer, said formation of said second via portion forming a metal polymer residue within said first and second via portions; and

applying a nitric acid-containing solution within said first and second via portions to remove said metal polymer residue.

5. (Previously Twice Amended) A residue-free contact opening in a dielectric layer over a metal-containing conductive pad for a semiconductor device extending from an upper surface of said dielectric layer to said metal-containing conductive pad, having substantially parallel sidewalls and formed by a method comprising:

providing a semiconductor substrate having a metal-containing conductive pad;

forming said dielectric layer over said semiconductor substrate and said metal-containing conductive pad with at least one opening extending from an upper surface of said dielectric layer to said metal-containing conductive pad, and wherein a residue resides within said at least one opening;

applying nitric acid within said at least one opening; and

subsequently applying a phosphoric acid solution including a fluorine-containing component within said at least one opening.

6. (Previously Twice Amended) A contact within a residue-free opening in a dielectric layer for a semiconductor device extending from an upper surface of said dielectric layer to a metal-containing conductive pad, having substantially parallel sidewalls and formed by a method comprising:

providing a semiconductor substrate having a metal-containing conductive pad;

forming said dielectric layer over said semiconductor substrate and said metal-containing conductive pad with at least one opening extending from an upper surface of said dielectric layer to said metal-containing conductive pad, and wherein a residue resides within said at least one opening;
applying a nitric acid within said at least one opening;
subsequently applying a phosphoric acid solution, including a fluorine-containing component, within said at least one opening; and
disposing conductive material within said at least one opening.

8. (Previously Twice Amended) A residue-free contact opening in a dielectric layer and a barrier layer for a semiconductor device including a semiconductor substrate having a metal-containing conductive pad under said dielectric layer and said barrier layer, said residue-free contact formed by a method comprising:
providing a semiconductor substrate having a metal-containing conductive pad;
forming said barrier layer over said semiconductor substrate and said metal-containing conductive pad;
forming said dielectric layer over said barrier layer;
forming a first via portion through said dielectric layer to expose a portion of said barrier layer, said formation of said first via portion forming an oxide polymer residue within said first via portion;
forming a second via portion through said exposed portion of said barrier layer, said formation of said second via portion forming a metal polymer residue within said first and second via portions;
applying nitric acid within said first and second via portions to remove said metal polymer residue; and
subsequently applying a phosphoric acid solution including a fluorine-containing component within said first via portion to remove said oxide polymer residue.

9. (Previously Twice Amended) A residue-free contact opening in a dielectric layer and a barrier layer above a metal-containing conductive pad for a semiconductor device, said residue-free contact formed by a method comprising:

providing a semiconductor substrate having a metal-containing conductive pad;

forming said barrier layer over said semiconductor substrate and said metal-containing conductive pad;

forming said dielectric layer over said barrier layer;

forming a first via portion through said dielectric layer to expose a portion of said barrier layer, said formation of said first via portion forming an oxide polymer residue within said first via portion;

applying a solution including a fluorine-containing component within said first via portion to remove said oxide polymer residue;

forming a second via portion through said exposed portion of said barrier layer, said formation of said second via portion forming a metal polymer residue within said first and second via portions; and

applying nitric acid within said first and second via portions to remove said metal polymer residue.